GEOMATRIX

FINAL

AOC-001 and AOC-002 INTERIM ACTION WORK PLAN

Boeing Renton Facility

Renton, Washington

Prepared for:

The Boeing Company
Boeing Environmental Affairs
Seattle, Washington

August 2005

Project No. 8888.002

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Boeing Renton Facility
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1.0 INTRODUCTION

The Boeing Company (Boeing) has been working with the Washington Department of Ecology (Ecology) to address historic releases of hazardous substances at the Boeing Commercial Airplane Group - Renton Plant (Facility) located in the City of Renton, Washington. This Interim Action Work Plan (Work Plan) has been prepared to support a Model Toxics Control Act (MTCA) Interim Action for two areas of concern (AOCs) under the authority of WAC 173-340-430. This Work Plan describes proposed remediation work for AOC-001 and AOC-002 (the Site).

1.1 SITE HISTORY

The northern portion of the Facility, where AOC-001 and AOC-002 are located, has been used for airplane manufacturing since before World War II. The area between Buildings 4-20 and 4-81 and Lake Washington is currently used for the outside storage of airplane jigs and miscellaneous parts. The area around AOC-001 and AOC-002 also serves as a tow path for partially completed aircraft. Due to the very high load-bearing capacity needed in this area, the concrete tarmac is commonly at least one foot thick and reinforced by rebar. These buildings and areas are currently used for industrial purposes and are expected to remain in industrial use for the foreseeable future.

1.2 SITE BACKGROUND

AOC-001 and AOC-002 are associated with former underground storage tanks (USTs) URE-01 and URE-02, respectively. The former steel USTs were located near the northwest corner of Building 4-81 in the northern portion of the Facility as shown in Figure 1. Both USTs were installed in 1980 for storage of methyl ethyl ketone (MEK) and toluene. Each steel tank had a capacity of 500 gallons, and both tanks were placed within a cylindrical concrete vault for secondary containment.

After these USTs were removed in July 1986, toluene was detected in the water within the secondary containment. Subsequent subsurface investigation identified toluene and vinyl chloride (VC) in groundwater samples collected in the area adjacent to URE-01 and URE-02.

Section 5.4 of the final Remedial Investigation (RI) report presents the complete RI characterization results for these units (Weston, 2001). This area was subsequently investigated in several phases of post-RI investigation to further delineate the nature and extent of affected soil and groundwater. The results of the first two phases of the post-RI investigation were reported in the Feasibility Study Work Plan (FSWP) (Geomatrix, 2004a). Additional sampling was conducted after completing the FSWP. The results of the third phase of post-RI investigation were reported to Ecology in the technical memorandum "Recommended Corrective Action Groundwater Monitoring Well Installation at AOCs-001, -002, and -003" (Geomatrix, 2004b). Soil and groundwater sample locations and analytical results above the general soil and groundwater cleanup levels defined in the Ecology-approved FSWP are presented in Figures 1 and 2.

1.3 RESULTS OF PREVIOUS INVESTIGATIONS

The following sections summarize hydrogeologic conditions and soil and groundwater quality results from the RI investigation and subsequent post-RI investigations.

1.3.1 Hydrogeologic Conditions

Fill materials consist of greenish-brown fine- to medium-grained sand with silt and gravel. Beneath the fill, the alluvium consists of greenish-gray clayey-silt to silty-clay with a high content of organic matter. Boring logs from the nine push probes conducted for the RI indicate that the depth of the contact between fill materials and alluvium range from approximately 6 to 10 feet below ground surface (bgs). Boring logs from monitoring wells and the recent deeper push probes show a continuous, lower-permeability peaty silt layer directly underlying the fill from approximately 10 to 24 feet bgs (Weston, 2001; Geomatrix, 2004a).

Groundwater levels during the RI (as measured in monitoring wells GW049, GW050, GW051, and GW052) ranged from 1.4 to 3.2 feet bgs. Seasonal variations in groundwater levels during the RI ranged from 0.35 to 0.64 foot. Groundwater elevations at the Site are strongly influenced by surface water elevations in Lake Washington. The U.S Army Corps of Engineers maintains Lake Washington water levels within a 2-foot range. The minimum elevation is maintained during the winter and typically allowed to rise starting in mid-February. By the end of April, lake levels are typically near the annual maximum elevations. Groundwater elevations near the Site follow a similar pattern, with annual low water elevations occurring during the winter months, and high water elevations occurring during the summer.

Groundwater contours included in the final RI report indicate that groundwater beneath the Site flows to the northwest toward Lake Washington at an average gradient of approximately 0.001. Slug tests were conducted in wells GW049, GW050, and GW051. These slug tests indicated that the hydraulic conductivity of the shallow aquifer ranged from 1.4 x 10^{-3} to 5.0 x 10^{-3} cm/s.

1.3.2 Soil Results

Site characterization data presented in the final RI report and in post-RI sampling indicate that there are two source areas related to the Site. The primary source area is located northeast of Building 4-20 (see Figure 1), approximately 200 feet southwest of the former USTs originally designated as AOC-001 and AOC-002. The secondary source area is in the vicinity of the two former USTs (URE-01 and URE-02). In general, the primary source area has higher constituent of concern (COC) concentrations than the secondary source area. Maximum detected concentrations of trichloroethene (TCE), *cis*-1,2-dichloroethene (*cis*-1,2-DCE), and VC in the primary source area were 190,000, micrograms per kilogram (µg/kg), 100,000 µg/kg, and 5,900 µg/kg, respectively. Gasoline-range total petroleum hydrocarbons (TPH-G) were also detected at a maximum concentration of 3,900 milligrams per kilogram (mg/kg).

Shallow soil samples were collected from the 14 push-probe locations (PP 140 through PP153) sampled at AOCs-001 and -002 (See Figure 1). The soil samples were collected by Geomatrix staff on June 6 in accordance with the draft AOC-001 and AOC-002 Interim Action Work Plan. The borings were located to better define the size of the interim action source removal. Each boring was advanced approximately 8 feet bgs and two soil samples were collected at each location, one from the water table interface and one from the bottom of the boring. All borings were lithologically logged during sampling.

The soil samples were analyzed for volatile organic compounds (VOCs) and total petroleum hydrocarbons (TPH) as gasoline. The complete results of the source area delineation investigation, including boring logs and analytical laboratory packages will be detailed in a memorandum that will be sent to Ecology before the interim action has started. In the interests of expediting the interim action, the soil analytical sample results shown in Figure 1 combine the soil analytical results of this investigation with the results of the earlier investigations that were completed at AOC-001 and AOC-002. The results of this investigation are similar and consistent with the results of the earlier investigations. VC, TCE, *cis*-1,2-DCE, and TPH-G were detected at multiple locations above the FSWP cleanup levels. The potential excavation area is shown in Figure 1, and measures approximately 40 feet by 40 feet.

1.3.3 Groundwater Results

The nature and extent of affected groundwater associated with AOC-001 and AOC-002 have been delineated through the RI, Supplemental RI, and subsequent site investigations. These investigations have identified a primary source area in the vicinity of PP136, PP137, and PP138 impacted by VOCs. Groundwater samples collected during the Supplemental RI and reported in the FSWP (Geomatrix, 2004a) and the more recent investigation (Geomatrix, 2004b) from the uppermost water bearing unit in the source area contained dissolved *cis*-1,2-DCE and VC at concentrations of 52,000 micrograms per liter (µg/L) and 28,000 µg/L, respectively. TCE has been detected in groundwater samples from this same area at concentrations up to 1,400 µg/L. TPH-G was not detected in groundwater at concentrations above the FSWP cleanup levels. Groundwater samples collected below the lower permeability peaty silt layer underlying the Site and downgradient from the primary source area did not exceed the FSWP groundwater cleanup levels for any of the VOCs.

The activities that caused the release of chlorinated VOCs area are not known. Given that tetrachlorethene (PCE) has not been detected, the primary solvent released appears to be TCE. The widespread presence of *cis*-1,2-DCE and VC, and relatively low concentrations of TCE in groundwater downgradient of the source area, indicate that biodegradation via reductive chlorination is active at the Site.

2.0 OBJECTIVES AND SCOPE

This Work Plan outlines the specific steps that will be taken for the planned interim remedial action at AOC-001 and AOC-002. The objective is to remove TPH-G- and VOC-affected soil exceeding the FSWP cleanup levels in the source area to the extent practicable and to remediate remaining VOC-affected soil and groundwater using in-situ bioremediation. The scope of this Work Plan includes additional source area delineation, soil removal, and remediation of remaining soil and groundwater through enhanced biodegradation.

3.0 INTERIM ACTION CLEANUP LEVELS

The goal of the interim action soil removal is to remove soil affected by COCs above the cleanup levels in the Ecology-approved FSWP. The FSWP cleanup levels will be considered the interim action cleanup levels. Soil confirmation sample analytical results will be compared to the interim action cleanup levels. If a soil confirmation sample contains COCs above the interim action cleanup level, additional soil will be removed within the site constraints; these constraints include the groundwater depth, the saw-cut sides of the excavation, and the presence of utilities in the excavation area. If affected soil containing COCs at concentrations above the interim action cleanup level is left in-place, the location and depth of the soil confirmation sample will be determined accurately in the field. The soil confirmation sample locations will be measured relative to the surveyed corners of the excavation to determine the state plane coordinates of the samples for future reference. Any impacted soil remaining in the excavation will be addressed during the ongoing Corrective Action process for the Boeing Renton facility.

4.0 INTERIM ACTION APPROACH

This section describes the approach that will be used to complete the interim action at AOC-001 and AOC-002. Figure 1 shows the location of these areas and the elements of the interim action. The planned approach includes excavating a conservative volume of soil from the area based on source area delineation, enhancing naturally occurring anaerobic biodegradation of VOCs through injection of an electron donor, and monitoring the attenuation of VOCs in groundwater.

4.1 OVERVIEW OF INTERIM ACTION

This interim action will be performed to remove, to the extent practicable, soils containing COCs at concentrations above soil cleanup levels specified in the FSWP. Constraints on soil excavation at the Site include depth to groundwater, above grade structures, and the presence of active subsurface utilities within the excavation area. Affected soils will be excavated to the water table and 1- to 2-feet deeper, if possible without compromising the integrity of the adjacent tarmac and utilities. Additionally, soils will be excavated as close as safety permits to the existing utilities. This approach is necessary due to the number of utilities in this area and the extensive reinforced-concrete tarmac in the area. Following soil removal, clean soil, crushed concrete, or gravel will be used to backfill the excavation and the concrete pavement will be replaced.

Biodegradation via reductive dechlorination is actively attenuating VOCs at the Site. Groundwater and any contaminated soil left in place in the saturated zone following soil removal will be addressed through enhancing the existing biodegradation processes by the addition of an electron donor. Groundwater quality monitoring will be performed to monitor the attenuation of COCs in groundwater downgradient of the source area.

4.2 SOIL EXCAVATION

Soils in the area of AOC-001 and AOC-002 that exceed the FSWP soil cleanup levels near PP138 (as shown in Figure 1) will be excavated to the water table, which is expected to be encountered at a depth of approximately 3 feet bgs. Additional soil below the water table may be excavated to the extent practicable without affecting adjacent soils supporting the tarmac. The final extent and volume of the excavation will be based on results of the additional source area delineation and depth to groundwater at the time the work is performed.

The existing pavement in the excavation area will be cut and removed prior to the start of excavation. Appropriate storm water management practices will be implemented to minimize the potential for runoff from the paved areas to enter the excavation. Several active utilities (fire protection water line, storm sewer, and water) cross the potential excavation area; excavation will proceed as close as possible to these utilities without risking the integrity of the utilities or sloughing of soils underlying the utilities.

Excavation will be completed using a backhoe or other means, and soil will be properly managed onsite prior to offsite disposal. Excavated soil will be stockpiled on a constructed pad or placed directly in roll-off boxes or trucks. If a constructed soil stockpile pad is needed, it will be fabricated out of 30-mil polyethylene sheeting, lumber, sand bags, and other appropriate materials. The lumber will be used to construct berms to minimize spills and runoff or runon. When the excavation is not active, the stockpiled soils will be covered by 6-mil polyethylene tarps to minimize rainfall infiltration. The covering tarp will be secured at the end of the working day with sand bags or other weights.

Excavated soil will be covered to minimize contact with precipitation, and water draining from stockpiled soils will be collected and containerized for proper disposal. Health and safety monitoring will be conducted during the excavation activities in accordance with the established health and safety program. A qualified field representative will observe the excavation and document the lateral extents and depth of soil excavation. Soil confirmation samples will be collected after the excavation has been completed. Table 4-1 lists the specific analytical methods that will be used for each of the soil samples to be collected under this Work Plan. Table 4-1 also lists the sample containers, holding times, and preservations for each of the analyses. Once soil removal is completed, the excavation will be backfilled with clean fill material and the overlying pavement will be replaced with a surface meeting Boeing tow-path tarmac requirements.

4.3 WELL INSTALLATION

Three shallow monitoring wells, one located immediately upgradient and two located downgradient of the primary source area, will be installed to facilitate monitoring attenuation of VOCs in groundwater (as shown in Figure 1). These wells will be installed to the top of the silty peat layer and screened through the entire saturated zone, with the top of the screen at about 3 feet bgs. Monitoring wells will be constructed with 2-inch-diameter PVC well screens and blank riser pipe and completed with flush-mount monuments. The monitoring wells will be developed following completion. All water produced during development will be containerized pending proper disposal. Well installation activities will be performed in accordance with Washington State Minimum Standards for Construction and Maintenance of Wells.

4.4 ENHANCED BIOREMEDIATION

Groundwater quality data suggests that PCE and TCE in groundwater are naturally degrading to the daughter products *cis*-1,2-DCE and VC through the process of reductive dechlorination. Following soil removal, the ongoing degradation processes will be enhanced by addition of an organic carbon source (electron donor) to soil and groundwater at the Site. This will be achieved by mixing the electron donor (e.g., molasses, lactate, EHC® [a combination of controlled-release carbon and zero-valent iron], emulsified vegetable oil, or a combination of these materials) into the clean backfill placed at the bottom of the excavation, by placing the electron donor into drilled boreholes in the backfilled excavation, and/or by placing the electron donor into three or four injection wells in the backfilled excavation area. By increasing the concentration of the electron donor, biological activity will be enhanced and the rate of biodegradation will increase, thereby destroying the chlorinated solvents and their degradation products.

Injection of the electron donor into the subsurface requires an Underground Injection Control (UIC) program registration. The UIC registration is regulated under the WAC 173-218. Injection of electron donor for bioremediation requires a Class V injection well permit. The bioremediation injection wells, if needed, will be registered with the state of Washington after installation. The UIC permit will be obtained after the wells have been installed.

4.5 GROUNDWATER MONITORING

Groundwater quality will be monitored at six monitoring wells (three existing and three to be installed under this Work Plan) to assess the progress of enhanced attenuation at the Site.

Monitoring will be performed as part of on-going monitoring at the Facility. Specific elements of the monitoring program will be included in the appropriate 2005 Corrective Action Monitoring Report.

4.6 WASTE MANAGEMENT

Waste management will follow the guidelines described in the approved RI Work Plan (Weston, 1998). Contaminated soil from the excavation and well installation will be managed by Boeing. Excavated soil will be contained in roll-off boxes, trucks, or on a constructed pad. Any water draining from the soil will be collected, containerized, and shipped offsite for proper disposal. Excavated soil will be covered to minimize rainfall infiltration. Soil will be shipped offsite following proper characterization and disposal in accordance with applicable state and federal regulations. All personal protective equipment and disposable material or equipment will be double-bagged and disposed of in Boeing waste containers.

4.7 STORM WATER MANAGEMENT

Appropriate storm water best management practices will be incorporated and maintained where necessary in order to prevent storm water runon and runoff into or from the excavation area or soil stockpile areas.

5.0 QUALITY CONTROL

The quality assurance and quality control (QA/QC) procedures outlined in the Quality Assurance Project Plan (QAPP) and presented in Section 6.0 of the approved RI Work Plan will be followed for soil and groundwater sampling performed under this Work Plan. All analytical data generated by the laboratory will be reviewed in accordance with the QAPP. Data quality review will assess laboratory performance relative to the QC specifications listed in Section 6.0 of the RI Work Plan.

6.0 PROJECT ORGANIZATION

All excavation, drilling, and well installation work will be conducted by Boeing or their designated contractor. Geomatrix will observe excavation and drilling work, log soil lithology, and collect soil samples for chemical analysis during completion of the excavation.

7.0 REPORTING

Analytical results from the soil source area delineation will be summarized in a memorandum and submitted to Ecology prior to starting source area excavation. A second memorandum will be prepared and submitted to Ecology documenting completion of interim action activities, including soil removal and monitoring well and bioremediation well installation.

8.0 SCHEDULE

Soil excavation is anticipated during the summer or early fall of 2005. Soil excavation is expected to require approximately one week. Timely approval of this Work Plan by Ecology is requested to support the excavation schedule.

Installation of the monitoring wells and bioremediation wells (if necessary) will be completed following soil excavation and will require approximately one week. Groundwater monitoring will start after an enhanced bioremediation monitoring program has been prepared, submitted to Ecology, and approved.

9.0 REFERENCES

Geomatrix, 2004a, Final Feasibility Study Work Plan, Boeing Renton Plant, Renton, Washington, April.

Geomatrix, 2004b, Recommended Corrective Action Groundwater Monitoring Well Installation at AOCs-001, -002, and -003 Technical Memorandum: Prepared for The Boeing Company, August 13.

Roy F. Weston (Weston), 1998, Remedial Investigation Work Plan, Boeing Renton Plant, Renton, Washington.

Weston, 2001, Remedial Investigation Report, Boeing Renton Plant, Renton, Washington, August.

GEOMATRIX

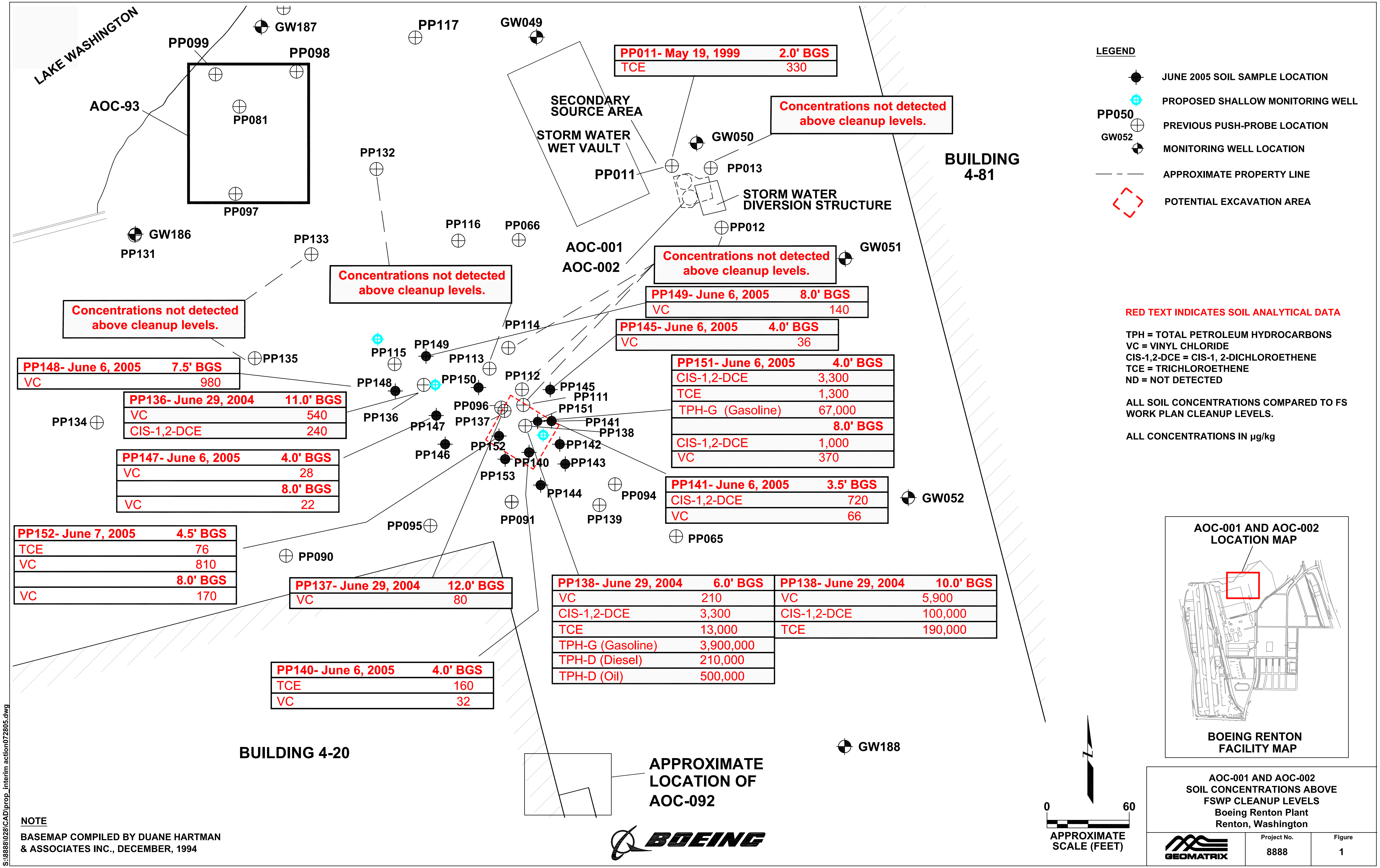
TABLE 4-1

PROPOSED SOIL SAMPLE ANALYSES

AOC-001 and AOC-002 Interim Action
Boeing Renton Facility
Renton, Washington

Sample Analyses	Analytical Method	Sample Container	Holding Time	Preservative
VOCs	Volatile Organic Compounds by EPA Method 8260B	40 mL VOA	14 days	at 4 degrees °C during transport; frozen upon reciept at lab
TPH-Gasoline	TPH-Gasoline by NWTPH-G	40 mL VOA	14 days	at 4 degrees °C during transport; frozen upon reciept at lab

1. All samples will be collected using EPA Method 5035 sample collection methods
2. VOC = Volatile Organic Compounds


LAKE WASHINGTON
AOC-93
PP099
PP098
PP081
PP097
GW187
PP117
GW049
GW186
PP131
PP132
PP133
PP116
PP066
SECONDARY SOURCE AREA
STORM WATER WET VAULT
PP011
GW050
PP013
STORM WATER DIVERSION STRUCTURE
PP012
GW051
AOC-001
AOC-002
BUILDING 4-81
PP011- May 19, 1999 2.0' BGS
TCE 330
Concentrations not detected above cleanup levels.
Concentrations not detected above cleanup levels.
Concentrations not detected above cleanup levels.
Concentrations not detected above cleanup levels.
PP149- June 6, 2005 8.0' BGS
VC 140
PP145- June 6, 2005 4.0' BGS
VC 36
PP151- June 6, 2005 4.0' BGS
CIS-1,2-DCE 3,300
TCE 1,300
TPH-G (Gasoline) 67,000
8.0' BGS
CIS-1,2-DCE 1,000
VC 370
PP141- June 6, 2005 3.5' BGS
CIS-1,2-DCE 720
VC 66
PP148- June 6, 2005 7.5' BGS
VC 980
PP136- June 29, 2004 11.0' BGS
VC 540
CIS-1,2-DCE 240
PP147- June 6, 2005 4.0' BGS
VC 28
8.0' BGS
VC 22
PP152- June 7, 2005 4.5' BGS
TCE 76
VC 810
8.0' BGS
VC 170
PP137- June 29, 2004 12.0' BGS
VC 80
PP140- June 6, 2005 4.0' BGS
TCE 160
VC 32
PP138- June 29, 2004 6.0' BGS
VC 210
CIS-1,2-DCE 3,300
TCE 13,000
TPH-G (Gasoline) 3,900,000
TPH-D (Diesel) 210,000
TPH-D (Oil) 500,000
PP138- June 29, 2004 10.0' BGS
VC 5,900
CIS-1,2-DCE 100,000
TCE 190,000
PP135
PP134
PP115
PP149
PP113
PP114
PP148
PP150
PP112
PP145
PP111
PP151
PP096
PP136
PP137
PP141
PP138
PP147
PP142
PP146
PP152
PP140
PP143
PP153
PP144
PP094
PP091
PP139
PP095
PP090
PP065
GW052
GW188
BUILDING 4-20
APPROXIMATE LOCATION OF AOC-092
BOEING
LEGEND
JUNE 2005 SOIL SAMPLE LOCATION
PROPOSED SHALLOW MONITORING WELL
PP050
PREVIOUS PUSH-PROBE LOCATION
GW052
MONITORING WELL LOCATION
APPROXIMATE PROPERTY LINE
POTENTIAL EXCAVATION AREA
RED TEXT INDICATES SOIL ANALYTICAL DATA
TPH = TOTAL PETROLEUM HYDROCARBONS
VC = VINYL CHLORIDE
CIS-1,2-DCE = CIS-1, 2-DICHLOROETHENE
TCE = TRICHLOROETHENE
ND = NOT DETECTED
ALL SOIL CONCENTRATIONS COMPARED TO FS WORK PLAN CLEANUP LEVELS.
ALL CONCENTRATIONS IN µg/kg
AOC-001 AND AOC-002 LOCATION MAP
BOEING RENTON FACILITY MAP
N
0
60
APPROXIMATE SCALE (FEET)
AOC-001 AND AOC-002 SOIL CONCENTRATIONS ABOVE FSWP CLEANUP LEVELS
Boeing Renton Plant
Renton, Washington
GEOMATRIX
Project No.
8888
Figure
1
NOTE
BASEMAP COMPILED BY DUANE HARTMAN & ASSOCIATES INC., DECEMBER, 1994
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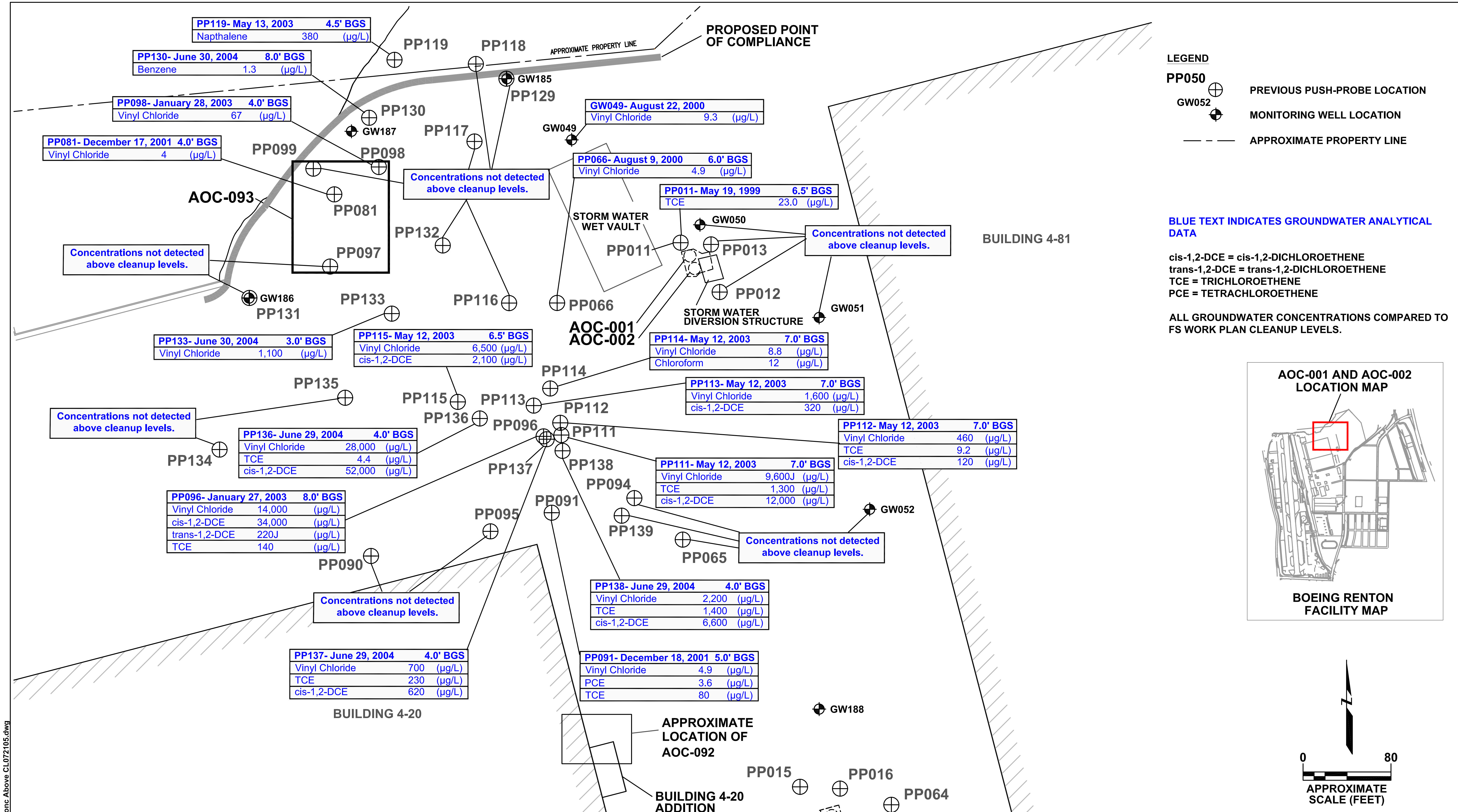

NOTE

BASEMAP COMPILED BY DUANE HARTMAN & ASSOCIATES INC., DECEMBER, 1994

AOC-001 AND AOC-002
GROUNDWATER CONCENTRATIONS ABOVE
FSWP CLEANUP LEVELS
Boeing Renton Plant
Renton, Washington

GEOMATRIX	Project No. 8888	Figure 2

S:\8888\028\CAD\AOC-1,2 GW Conc Above CL072105.dwg